# A magnetic loop antenna

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My interest in this type of antenna goes back some years after attending a lecture and demonstration on the subject, which wasn't really a success since the antenna didn't work as planned.

Actually, little is known about this antenna - whilst the principle is quite old, many odd stories did and still do the rounds.

## Calculations and construction

At that time I owned a computer programme designed for loop antennae, called 'T-loop'.

Input requirements consisted of such items as size, whether round, square or hexagon.

Based on these details, the programme works out the size of the capacitor and the plate size and its spacing.

Say you select a loop diameter of three feet (the software calculates in imperial), the circumference calculated is: 3 x 12 x 25.4 x 3.14 = 2871 mm.

[Where:
3 is the diameter (in feet)
12 inches per foot
25.4 millimetres per inch and
$\pi$ is approximately 3.14
The actual formula is
$C = \pi D$]

This is the size I chose to make the loop square with the side measuring 800 mm. (Figure 1 and Photo 1)

The selected material consisted of 22 mm copper tubing, with 90 degree solder joints to make a square. It may be better to manufacture the square out of one piece of tubing long enough, but that requires special tools that I did not possess.

Aluminium tubing is an option but that creates soldering problems.

I decided on the size of the loop with the aid of the software, varying the required operating frequencies. This resulted in varying values for the tuning capacitor, in my case from 7 to 400 pF in order to operate from 10 metres to and including 40 metres - more about this later.

The coupling inductor (coil) is made from 6 mm copper brake line as used on older type automobiles (6 mm soft drawn solid wire would also do the trick). The coupling is provided with an SO239 connector to connect co-axial cable. The length of the coupling inductor should be 1/6th the length of the major loop.

Because these loops on HF appear as coils, and can be considered as such, an impedance transformation results – see Figure 1. The coupling inductor is insulated by means of shrink tube and placed in a corner of the major loop connected in a mechanically stable manner. The major loop has an opening of 80 mm at the bottom and is rigidly connected to a piece of 'trespa' sheeting of about 6 mm thickness. I used plumbing fittings such as those used to connect taps to walls; a plumber would use these to connect 22 mm pipes. The three holes to connect the tap fittings come in handy for use of M3 hardware. The lot is held in place with nylon saddles as used by the same plumber – see Photo 2.

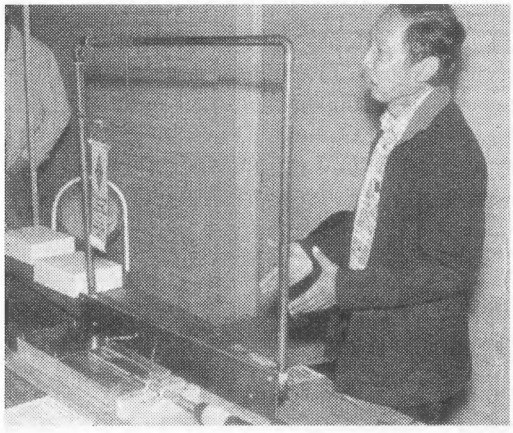

Photo 1 Wil PE1LKT

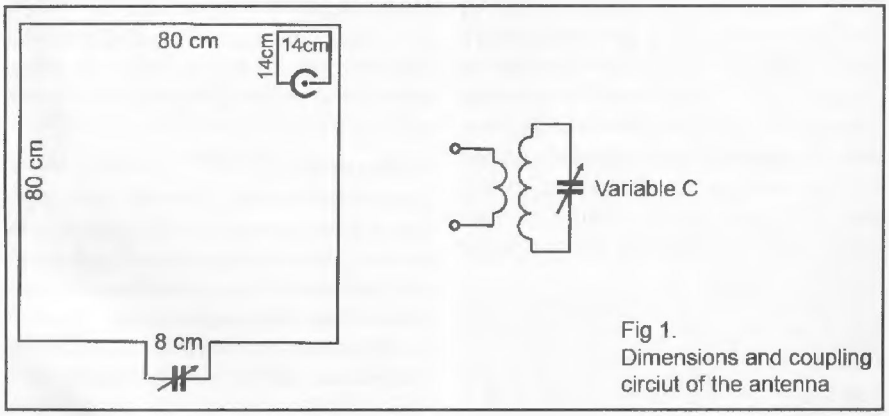


Fig 1.
Dimensions and coupling circiut of the antenna

Figure 1

## The tuning capacitor

A commercial tuning capacitor may be available but making one to suit is 'nicer'.

A capacitor is defined as two conductors separated by a dielectric. Determining the capacitance is no problem; you would have learnt that in studying for your exams.

In practice, it often works out differently. Theory says it should work and sometimes it doesn't, whereas a practical approach will sometimes.

Circuit board material is covered with a layer of copper and two pieces separated by air (dielectric) form a capacitor.

The required separation was determined by the above computer programme, bearing in mind the voltages across the plates.

Because the capacity needed to be in the order of 400 pF required too great a surface area, I subsequently choose to

manufacture a 'packet' of circuit board material consisting of five stationary and four movable pieces of double sided material separated by strips of plywood; 20 mm and 30 mm wide respectively. The wider strips are used to separate the stationary plates and the narrow ones to allow the movement of the 'packet' that will move in between the fixed plates (Figure 1 and Photo 2).

The fixed plates measure 210 mm x 170 mm and are provided with holes of 1.5 mm at their extremities. A wire is to be threaded through and soldered to the individual plates after assembly.

The movable plates measure 210 mm x 130 mm and with M3 threaded rod and M3 nuts manufactured in such a way that easy movement results between the plates. When satisfied solder the nuts to the circuit board. Measurement indicated a maximum of 400 pF, sufficient for my purpose.

The capacitor is mounted on a suitable piece of 'trespa' material at right angles to the 'trespa' plate supporting the loop. I made the connection from the capacitor with a flattened piece of co-axial outer cable. Melt some solder at the ends and pierce a hole large enough to allow an M3 bolt and connect to the loop, the fixed plates and the movable plates. An advantage of this type of capacitor over a conventional one is the lack of mechanical noise sometime resulting from dusty bearings.

Initially I connected a strip of Plexiglas to the movable plates to move, by hand, into the fixed portion of the 'packet', with pencil marks to indicate the settings for the various amateur bands. Tuning is simple and quick. Place the Rx somewhere in the middle of the band of choice, move the plates and upon approximate resonance, audible (noise) and noticeable ('S meter') the antenna is then ready to transmit. Fine tune for minimum SWR and 'Bob's your uncle'.

## Results

I've made contacts [from the Netherlands] on all bands between 7 MHz and 30MHz with contacts to Argentina, USA and Brazil. European stations are readily contactable. The antenna is quite frequency wise, which has the advantage of suppressing stations close by in frequency. It's a very quiet antenna, less noise pick-up or QRN, even thunderstorms are hardly audible.

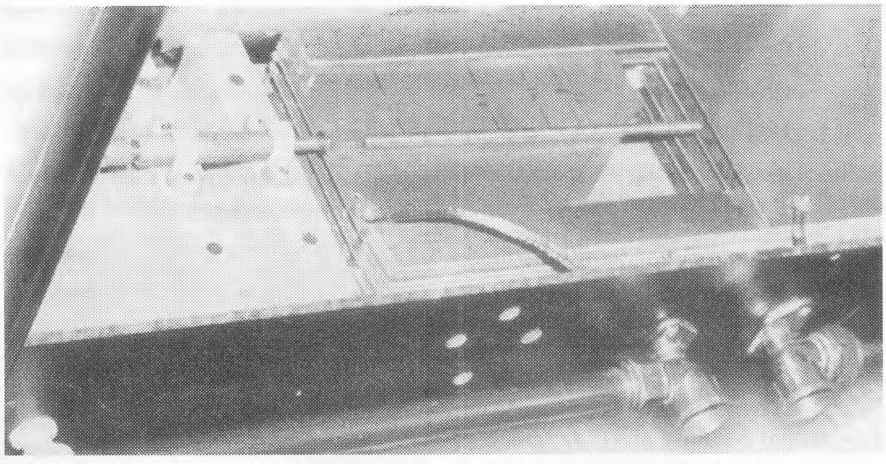

Photo 2: A nice bit of plumbing

Costs have been kept to a minimum and there's much room for improvement.

In order to adjust the capacitor more easily, I connected a cordless screwdriver with a piece of M8 threaded rod that turns in an M8 nut, fastened to the movable plates with the assistance of a M3 nut. A spacer (washer) will aid in lining up for the correct height.

M8 has a turn ratio of 1.25 mm. ergo; it follows that for every turn the plates will move 1.25mm. A driver at 140 rpm will move the plates 175 mm. To insulate the screwdriver, I connected a piece of flexible hose material of suitable size between the drill and the threaded rod. At first I omitted this resulting in a burnt out cordless drill and its battery pack due to high RF currents. The connecting bit, being flexible assists in lining up the rod. The threaded rod is held in place by a piece of aluminium tube, inside diameter of 8 mm.

It is important to be aware of the high RF currents, and the high magnetic fields should not be ignored.

Other materials could perhaps be used. I used what was at hand; it does not have to appear as if made commercially. The important thing is that the antenna functions well and that one gets to understand what one does and what one talks about and the satisfaction

(Translator's note: The magnetic fields produced by a Loop antenna when used indoors and close to the operator could/ would create problems for those fitted with Pacemakers such as in my case).

Editor's note: John Lauten VK4VK advises the following: "Trespa is a trade name. The material is extremely hard and is the same material used in the type of flooring you may see advertised on the television. It looks for all the world like timber. It's very popular in Europe. I suppose you could substitute hardboard or "burnie board", as long as it isolates and is strong enough to do the job."

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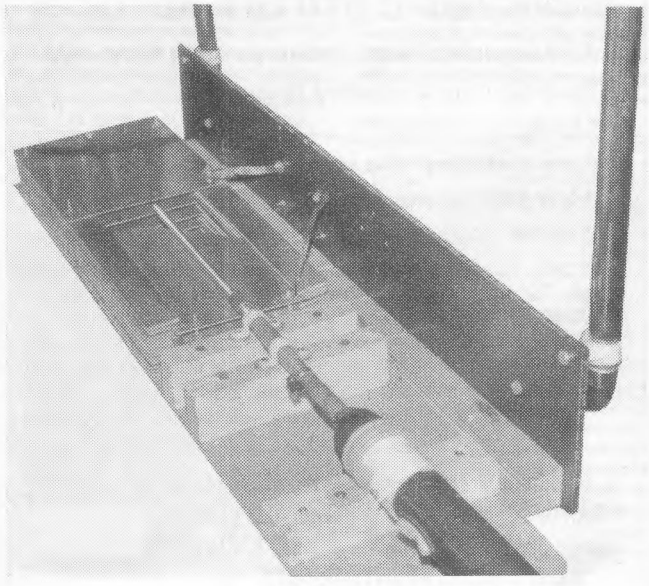

Photo 3: the condenser